#19 Sub Spec (C1) 11-8-03

C4

In the Specification:

Please replace the original specification with the substitute specification below. Also attached is a marked-up version of the original specification as required under rule 37 CFR 1.121(b)(3)(iii). Pursuant to rule 1.121(f), the substitute specification contains no new matter.

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a non-provisional claiming priority to provisional U.S. application number 60/224,312 filed 8/10/00.

FIELD OF THE INVENTION

The present invention relates to ski bindings that automatically release when a skier triggers a remote transmitter by pushing a button on the ski pole, bindings, or other suitable location.

BACKGROUND OF THE INVENTION

It is estimated that over 10,000 crippling knee injuries occur each ski season in Colorado, U.S.A., alone. Extrapolating worldwide there might be over 50,000 knee injuries each ski season worldwide. Great advances have been made in downhill ski bindings to automatically release during violent forward falls. However, several problems still exist with the best downhill ski bindings.

A serious problem is the slow, twisting backward fall. Most anterior cruciate ligament (ACL) injuries occur with this type of fall. Expert skiers teaching children fall during a lesson and tear their ACL. A damaged ACL can be treated with a modern, complex, and expensive

surgery called a patella tendon graft replacement for the ACL. Other body parts such as the hamstring tendon can also be used to replace the damaged ACL.

Thus, two surgeries are required. First a body part such as the patella tendon is harvested. Second the damaged ACL is removed and replaced with the harvested body part.

A good result requires six months for the replacement ACL to gain strength and function like the original ACL. About a year's physical therapy is required to regain maximum use of the leg. Two wounds must heel, without infection. Stiffness related to scar tissue in the knee joint sometimes leads to loss of full range of motion. Atrophy of the leg muscles from the downtime of surgery adds stress to the already weakened knee. Additional ACL and related injuries can occur. An average cost of one procedure with therapy is about $15,000.00.

All this misery can stem from one careless fall backwards while standing in the ski line. Following your child at 3 mph can lead to a slow backwards fall and a crippling ACL injury. Nobody has invented a working solution to this one worst injury so frequently caused by a careless moment on downhill skis.

One new attempt to solve this problem is the Lange® ski boot with a rearward pivot ankle segment. A pre-set backward force will release the ankle segment of the boot rearward. However, the boot is still locked into the ski binding. Only twelve pounds of twisting torque on the foot is required to tear an ACL. The Lange® boot solution does not address the release of rotational force on the knee. It addresses the release of a rearward force by the boot on the back of the skier's calf. It is unknown if this system will reduce ACL injuries.

A large portion (perhaps half) of all ACL injuries occur at slow speeds falling backwards. Therefore, a couple of seconds of reaction time exists for a trained skier (either novice or expert) to push an emergency release button on his ski pole handle or other suitable location and totally

eject from his skis. By the time the skier hits the ground, he's out of his skis without exerting any rotational torque to his knees. Properly trained skiers using the present invention can reduce the risk of ACL injury by a large percent, perhaps even half. This could mean 25,000 fewer worldwide ACL injuries a year, and a much safer sport overall.

Other uses for this emergency release system (also called a bail out™ system) include easy release for beginners so they can spend less time learning to stand up, and more time skiing. Upside down skiers in a tree hole can quickly release and quickly get out of a dangerous situation.

The basic principle of the present invention is to mount the heel and/or toe release segment of a ski binding on a short track. Pushing the release button energizes a stored force on the ski to move the heel and/or toe binding along the track to a position larger than the ski boot. The result is a size 10 boot in a size 12 binding. The skier is instantly free of his skis.

a To remount the skier resets his binding to the loaded and properly sized position, steps in, and skis as usual.

SUMMARY OF THE INVENTION

The main aspect of the present invention is to provide a track on a ski binding element, wherein a remote release button powers the ski binding element to move on the track to a position larger than the skier's proper boot and binding locked position.

Another aspect of the present invention is to provide a transmitter button on a ski pole or other suitable place to activate the movement of the ski binding on the track.

Another aspect of the present invention is to provide a compressed gas canister on the ski to move the ski binding element on the track.

Another aspect of the present invention is to provide a mounting plate with a track to house a toe and heel element of a ski binding.

Another aspect of the present invention is to provide a loud "bang" noise by remote control in order to locate a ski lost in powder.

Another aspect of the present invention is to use colored gas to more easily locate a lost ski in powder by remote control.

The preferred embodiment uses the stored energy of a compressed gas in a housing mounted to a ski binding toe or heel element. A radio signal activated mechanism releases the gas which moves the ski binding element along a track to very rapidly release a skier from his binding.

To reset the binding, the gas from a replacement compressed gas canister is released against a piston which forces the moveable portion of the binding to move along the track so that the distance between the toe piece and heel piece is reduced to the original skiing position.

C1

All normal functions of a modern, forward release ski binding remain intact.

Initial prototypes prove the concept of building a track style release mechanism which can use off-the-shelf ski bindings.

Future models of the track style release binding could be factory built with the ski binding installed.

Other aspects of this invention will appear from the following description and appended claims, reference being made to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a right side plan view of a gas operated release embodiment, the preferred embodiment.

FIG. 2 is the same view as FIG. 1 with the ski boot released.

FIG. 3 is a longitudinal sectional view of the gas operated release mechanism.

FIG. 4 is a cross sectional view taken along line 4-4 of FIG. 3.

FIG. 5 is a cross sectional view taken along line 5-5 of FIG. 3.

FIG. 6 is the same view as FIG. 3 with the gas cylinder unopened.

FIG. 7 is a cross sectional view taken along line 7-7 of FIG. 6.

FIG. 8 is a cross sectional view taken along line 8-8 of FIG. 6.

FIG. 9 is a right side partial sectional view of a plank mount embodiment.

C1

FIG. 10 is a top plan view of the plank mount embodiment.

FIG. 11 is a cross sectional view taken along line 11-11 of FIG. 10.

FIG. 12 is a right side plan view of the plank mount embodiment.

FIG. 13 is a longitudinal sectional view of an alternate embodiment gas release mechanism.

FIG. 14 is a right side plan view of a toe piece track release embodiment.

FIG. 15 is a partial cutaway view of the ski pole handle transmitter.

FIG. 16 is a cross sectional view taken along line 16-16 of FIG. 15.

FIG. 17 is a top perspective view of the spring release mechanism embodiment.

FIG. 18 is a left side plan view of the spring release mechanism embodiment.

FIG. 19 is a right side view of the spring release mechanism embodiment.

FIG. 20 is a top plan view of the spring release mechanism embodiment.

FIG. 21 is a bottom plan view of the spring release mechanism embodiment.

FIG. 22 is a rear plan view of the spring release mechanism embodiment.

FIG. 23 is a front plan view of the spring housing of the spring release mechanism embodiment.

FIG. 24 is a longitudinal sectional view of the spring housing (released) of the spring release mechanism embodiment taken along line 24-24 of FIG. 22.

FIG. 25 is a same view as FIG. 24 with the spring housing locked.

BRIEF DESCRIPTION OF THE INVENTION

Referring first to FIG. 1 a downhill ski **1** has a traditional forward release binding system **2** comprising a toe release mechanism **3**, a heel release mechanism **4** and a snow brake **5**. When the skier **7** falls forward his boot **6** moves forward in direction **F** thereby releasing the binding system **2** in a known manner. Upon release the snow brake **5** is thrust downward.

C1

The heel release system mounts the heel release system **4** on a track **11**. Anchors **8,9** hold the track **11** on the ski **1** and enable the track **11** to move forward and backward. Fasteners **10** hold the anchors **8,9** to the ski **1**.

The heel release mechanism **12** has a piston arm **13** that is shown holding the heel release system **4** in the forward skiing position. The binding system **2** functions as a standard ski release system. The piston arm **13** connects to a flange **15** at the rear of the track **11**. A hole (not shown) in the flange accepts the piston arm **13**. Adjustment nuts **14** clamp the piston arm **13** to the flange **15**.

The body **16** of the release mechanism **12** has a gas cylinder chamber filled with compressed gas (preferably CO_2) which forces a piston forward as shown.

The principle of the release system of the present embodiment uses the concept that moving the heel release mechanism **4** a distance **D2** (or a portion thereof) opens the binding system **2** to a size too big to hold the boot **6**. The boot **6** will release in every direction especially

backward when the binding system **2** is opened via the track **11**. The distance **D1** is the proper distance between the toe and heel release members to fit the boot **6**. In prototype mode the distance **D2** is about a half inch to about one inch.

The release mechanism **12** shown is a CO_2 gas cartridge activated device. The skiing position shown has a gas cylinder cartridge **18** in the housing **16**, wherein the lever arm **17** has pushed the head of the cartridge **18** into the puncture pin **21** inside the housing. A piston (FIG. 3,**30**) is forced forward. Thereby holding the track **11** in the skiing position. This is a failsafe design in that a failure in the gas system results in the track moving backward, wherein the skier can't lock into his bindings.

C1

For a release (either emergency or normal) a radio signal is received by the receiver **19**. A linear motor or equivalent device such as a solenoid raises a plug **20** and releases the compressed gas from the housing **16**. Then a powerful spring (FIG. 3, **42**) forces the piston (FIG. 3, **30**) backward, quickly releasing the boot **6** from the binding system **2**.

Referring next to FIG. 2 the skier **7** has hit his release button (preferably located on his ski pole handle). At release time the skier was leaning back. His boot has released up **U** and back **B**. Thus, an injury to the ACL has been avoided. Prototypes prove this release, even in a fully loaded (backward) fall position, will occur before the skier hits the ground.

At release time the snow brake **5** has pivoted down via the brake release pedal **31** in a known manner. Distance **D3** is too long to hold the boot **6** in the binding system **2**. Distance **D4** is less than **D2**, and is a design choice. The prototype worked at **D2** - **D4** = one inch or less.

Referring next to FIGS. 3,4,5 the prototype gas release system **12** is shown. The body **16** houses a plunger **35** for controlling the compressed gas **CG**. The lever arm **17** can be pivoted to the open and closed positions. The opening spring **42** has been compressed by the force of the

compressed gas **CG** in the cylinder **34** on the piston **30**. The channel **33** provides a fluid communication with the cylinder **34**. An optional maintenance cap **53** is shown.

To release the skier from the binding the spring **42** needs to be released, and cylinder **34** needs to be discharged. This is done by retracting plug **20** from detent **37** in plunger **35**. Gas in cylinder **34** pushes thru port **349** moving plunger **35** to rear of port **349** breaking seal at "O" ring **349**"S" and exposing exhaust port **3490**, as shown in FIG. 6. This allows gas in cylinder **34** to escape to open atmosphere via vent **3490** and release all pressure on spring **42**. Since piston arm **13** is attached to flange **15** by adjusting nuts **14** (two each), it moves track **11** and removes all holding power from the heel release **4**. This immediately disconnects ski boot **6** from ski **1**. As gas exits from port **3490** the tone of sound and decibel loudness may be greatly changed by size and design of port **3490**.

C1

When the cylinder **34** needs to be discharged, plug **20** is pulled up by a linear motor (not shown) in the actuator/receiver housing **39**. The battery **370** powers both the radio receiver (not shown) and the linear motor. When the linear motor is in the valve closed **VC** position as shown in FIG. 4, the cylinder outlet **349** is closed by the plunger **35**. The plunger **35** is held in the closed position by the plug **20** that fits into detent **37**. A linkage **41** to the linear motor moves the plug **20** from the valve open **VO** to the valve closed **VC** positions.

In FIG. 5 the head **50** of the CO_2 cartridge **18** can be seen. It is pierced by the puncture pin **21** when the lever arm **17** is closed manually. Bolts **52** secure the housing **16** to the ski **1**. The weight of the heel release mechanism **12** in the prototype was 1½ pounds, which did not effect skiing. The radio transmitter/receiver and linear motor of the prototype were taken from a radio controlled model airplane.

Referring next to FIGS. 6,7,8 the release system **12** has been released via the receiver **38** activating the linear motor to pull the linkage **41** to the valve open **VO** position. Compressed gas has escaped through the cylinder outlet **349** and port **3490**. A design choice allows a loud "bang" type noise (to find skis in powder) or a quiet mode. Also a colored gas can be used to help find skis in powder.

For re-charging the system a new cartridge **180** is shown in dots. The lever arm **17** is shown open.

Referring next to FIGS. 9,10,11,12 the equivalent system to that shown in FIGS. 1-8 has been modified to include a mounting board **900** that holds all the system components. The mounting board **900** is screwed to the ski **1** with screws **910**. A groove **912** on the top of the mounting board **900** houses the track **11**. The track **11** has the same flange **15**. The ends of the groove at **913,914** are sized to allow the proper movement of track **11**. Holes **902** provide for proper installation of the heel release **4** based on size. This mounting board could be used for the preferred embodiment of FIGS. 1-8.

C1

Referring next to FIG. 13 a reverse action gas release system is shown wherein the track **11** and flange **15** are the same as the earlier embodiment. In this case the skiing position is shown wherein the spring **1302** holds the piston **1301** all the way forward as shown. No compressed gas has been discharged yet.

The receiver and linear motor unit **1305** is activated by the same radio signal as the earlier embodiment. The linear motor unit **1305** forces a probe **1304** into the head of the compressed gas cylinder **18**. Compressed gas **CG** flows through the channel **1306** to the cylinder **1300**, thereby forcing the piston **1301** and the flange **15** backward and releasing the skier (normally without a bang). The piston ring **1307** is designed to slowly release the compressed gas after

release (in perhaps a minute). For loading up the gas canister **18** a latch type door **1303** may be used.

Referring next to FIG. 14 a moving toe piece embodiment is shown. The heel piece **4** remains fixed while the toe piece **3** is pulled forward **FR** by the flange **15** in a like manner as the earlier embodiments. In this case the ski moves backward relative to the release system **12,** where in the heel mounted release systems the ski moves forward.

Referring next to FIGS. 15,16 the ski pole **1500** has a handle **1501**. An activator button **1502** is mounted on top of the handle for thumb activation. Accidental discharges are prevented by safety switch **1503**. The safety on **S-ON** position prevents the depressing of button **1502** because segment **1509** inserts into a hole in button **1502,** locking it. In the safety off position **S-OFF** the button **1502** is free to be activated. Normally the skier would move to the **S-OFF** position only during a ski run, not on the lift or during transport.

C1

For release the button **1502** closes switch **1504**. The battery **1505** energizes the transmitter **1506** which sends signals **1508** to the ski mounted receiver. Known multiple frequency methods are used to create a large number of different frequencies in the field so as to prevent one skier from releasing another's bindings. Short range transmitters also minimize this risk.

Referring next to FIG. 17 a ski boot **220** is shown stepping into a prior art downhill ski binding **221** which consists of a toe piece **222** and a heel piece **223**. The dotted lines of the ski boot **220** show the traditional downward movement of the ski boot **220** for locking into the ski binding **221**. The toe piece **222** is screwed into the ski **224** in a known manner. The proper mounting distance between the toe piece and heel piece for boot **220** is shown as **D2** (distance for skiing).

The heel piece is mounted to the track **225** instead of the ski **224**. The track **225** can be a flat metal strip which slides under anchors **226** which are fastened to the ski with screws (or bolts) **227**. A notch **231** under the anchors **226** receives the moveable track **225**. When the spring release mechanism **230** pulls the track rearward for a release, (shown by arrow) then the distance between the toe and heel pieces increases to **D** (distance for release).

The track **225** has a rear flange **228** which is connected to a shaft **229**, which in turn is directly attached to a central piston (FIG. 25, **300**). The spring release mechanism consists of a main housing **232**, a receiver **234**, a solenoid **235**, an electronics housing **2350**, a plunger **236**, a trigger **237**, and a trigger support **238**. The outer case for the above components has been removed.

C1

In operation a skier cocks the spring release mechanism to the ski position shown in FIG. 25. A lever **240** (such as the tip of a ski pole) is used to push the central piston crank arm **301** forward in direction F. This is accomplished by pulling the lever **240** rearward in direction R against the fulcrum **241**. The fulcrum is shown as a simple piece of metal extending rearward from the main housing **232**. Now the traditional ski binding **221** functions in the traditional manner to release upon a forward force from the ski boot **220**. However, as shown in FIGS. 15,16 a signal **1508** (preferably a radio signal) is generated by a skier to demand the instant release of his bindings. The receiver **234** receives the signal **1508** and activates the solenoid **235** to extend the plunger **236**, thereby tripping the trigger **237**. When the trigger **237** is tripped, the stored energy of the main spring (FIG. 24, **290**) forces the central piston (FIG. 24, **3000**) to the release position as shown in FIG. 24. The track **225** is pulled rearward in direction **R**, and the distance between the toe and heel pieces increases to distance **D**. In prototype mode the difference between **D** and **D2** is approximately one inch.

Referring next to FIGS. 18,19 the external appearance of the trigger **237** and its related functional parts is shown in plan view. The housing **232** forms a base for the fulcrum **241**. A slot **401** allows adjustment of the rearward positioning of the fulcrum **241** with bolts **400**. The solenoid is mounted inside the electronic housing **2350**, said housing counteracts the electronic force generated to move the plunger **236** rearward to trigger the trigger **237**. Bolts **2290** secure the shaft to the flange **228**. The trigger **237** controls the movement of a sear (also called a locking pin) **3000**. A base **3015** forms a pivot for the sear **3000** to pivot from.

Referring next to FIGS. 20,21,22,23 the solenoid and electronic components have been removed to better show the mechanical parts. The spring housing **232** has mounting holes **2600** on the bottom for attachment to a ski. A bolt **2507** secures the trigger housing **238** to the spring housing **232**. A bolt **2509** secures the sear base **3015** to the spring housing **232**. Pin **3086** is a forward stop for the trigger **237**. Pin **3005** is a pivot for the trigger **237**. Pin **3006** is a stop for spring **3007** which pushes the trigger **237** over the sear **3000** in the cocking operation. Pin **3002** is a stop for spring **3003** which pushes the sear **3000** into the groove **3012** which is located on the peripheral surface of central piston **300**.

The operation of the spring mechanism **230** is best seen in FIGS. 24,25. The electronic parts have been removed. The technical challenge is to store enough energy in the spring **290** to violently pull the track **225** rearward on demand to release. The further challenge is to work with the limited power available with a lightweight battery pack on board the ski. Too much added weight is not practical for downhill skis. The solution is a sear **3000** which has a locking corner **3011** which is forced into a locking engagement with a locking edge **3010** of the groove **3012** on the outside of the central piston **300**. The spring **3003** forces the sear downward in direction **D**

when the spring is fully compressed. This locked and ready to ski mode is shown in FIG. 25. The spring **3007** forces the trigger **237** to lock the sear down.

When the skier pushes his release button to send a (preferably radio) signal to the receiver **234**, the solenoid (or linear motor) is powered, thereby forcing plunger **236** against the trigger **237**. The trigger **237** has a pivot pin **3005**, and so the plunger **236** moves the locking bottom edge **3009** off the top of the sear, thereby allowing the spring **3003** to raise the sear around its pivot pin **3001**. As this occurs the locking surfaces **3010,3011** are released, and the spring **290** violently discharges its stored energy and pulls the track **225** rearward. This rearward force does overcome both the force of the weight of the skier as well as the force of any ice and debris that has collected on the ski. The release mode is shown in FIG. 24. The cavity **3004** in the sear **3000** holds the spring **3003**.

C1

Although the present invention has been described with reference to preferred embodiments, numerous modifications and variations can be made and still the result will come within the scope of the invention. No limitation with respect to the specific embodiments disclosed herein is intended or should be inferred.

Before explaining the disclosed embodiment of the present invention in detail, it is to be understood that the invention is not limited in its application to the details of the particular arrangement shown, since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.